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David K. Goldstein
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October 1992

CISR WP No. 244
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ABSTRACT

How are managers using computer-based data in their day-to-day work? When are they more likely to use these data? We addressed these questions through a qualitative study of the use of computer-based data and analytic tools by marketing product managers focusing on 16 product management work units at five grocery manufacturers. Our results indicate that these managers made extensive use of computer-based data to make sense of their environment and how it was changing. Further, we found that the factors that most greatly influenced use were characteristics of the product managers' environment. Through an inductive analysis we developed a set of propositions that relate four environmental characteristics — complexity, dynamism, uncertainty, and analyzability — to the degree to which managers use computer-based data. Finally, we will describe three configurations or groupings of these characteristics and of the marketing mix employed by these managers that further explained some of the variation in use of data among managers.

Organizations are confronted with a data explosion. Over the last twenty years MIS groups and software vendors have developed sophisticated transaction processing systems that capture data from the factory floor to the supermarket checkout counter. For example, marketing managers at Kellogg's can purchase tens of gigabytes of data describing the sales of Corn Flakes and other cold cereals in the United States[1]. At the same time, the tools available to analyze these data, most prominently spreadsheet software that runs on personal computers, have become both widely available and increasingly easy to use. These phenomena have created significant challenges for organizations, who are attempting to determine how to best use these data and analytic tools.

Unfortunately, there is lack of empirical research examining how computer-based data and analytic tools are being used in organizations. We will address two questions relevant to both managers and researchers: 1) how are managers using computer-based data in their day-to-day work and 2) under what circumstances are decision makers more likely to use these data? While we will provide some insights into the first question, our focus will be on the second. Since it is costly to provide managers with computer-based data and the tools to analyze them and since there is ample evidence that when information technologies are provided to managers they are not always used (Alavi and Henderson, 1981; Nickerson, 1981), it is critical to understand when managers most use data.

In a study of grocery product managers, we found that the use of computer-based data was widespread. These managers made extensive use of computer-based data to make sense of their environment and how it is changing. Further, we found that the factors that most greatly influenced use were characteristics of the product managers' environment. In presenting our results, we will first describe how these managers used computer-based data and the tools they had to analyze these data. We will then present a set of propositions that relate four environmental characteristics — complexity, dynamism, uncertainty, and analyzability — to the degree to which managers use computer-based data. Finally, we will describe certain groupings of these characteristics that are common and can explain some of the variation in use of data among managers.

BACKGROUND

Since information technologies cannot benefit organizations unless they are used, MIS researchers have focused a great deal of attention on factors that affect the use of information technology (Swanson, 1988). As personal computers have become ubiquitous in the workplace,

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1 Personal communication, Information Resources Incorporated.

MIS researchers have turned their attention to factors that affect the use of end-user systems — information technology utilized directly by non-technical knowledge workers and managers. These researchers have employed two perspectives to examine the degree to which knowledge workers and managers use various software packages.

One set of research is based on the theory of reasoned action (Fishbein and Ajzen, 1975). Using this model, Davis, Bagozzi and Warshaw (1989) found that perceived usefulness of software, and to a lesser extent its perceived ease of use, predicted both subjects' intention to use the software and their actual later use. They conducted their study with college students using word processing software. This result was validated, using a slightly different model, by Mathieson (1991).

A second set of research is based on the theory of diffusion of innovations (Rogers, 1983). Brancheau and Wetherbe (1990) found that early adopters of spreadsheet software were younger, more highly educated, and more likely to be opinion leaders than later adopters and non-adopters. This research builds on a long tradition of applying innovation diffusion theory to the study of the introduction of information technologies (see Cooper and Zmud, 1990).

Unfortunately, these two approaches do not adequately reflect the reality faced by many knowledge workers and managers who use these 'end-user systems.' These managers are confronted with a great deal of computer-based data that emanate from many sources, both internal and external. The data might be in the form of reports, they might be accessible from a mainframe-based decision support system, or they might be available on a PC-based spreadsheet or data base package. Knowledge workers might then combine data from many sources and analyze it using the PC, a calculator, or a pencil and paper. Hence, use of a specific software package is less relevant to these managers than effective analysis of computer-based data. There is even some evidence that managers in successful organizations make more extensive use of real-time computer-based data in their decision-making (Eisenhardt, 1989a). At the same time, there is no evidence of any relationship between the use of spreadsheet or word-processing software and managerial or organizational performance.

In addition, by focusing on individual managers and their attitudes, these studies do not adequately consider the role of organizational context. The environment faced by an organization could have a significant impact on a knowledge workers' use of information technology. For example, managers facing a rapidly changing environment might monitor the environment more closely to detect and react to the changes, and hence make more extensive use of computer-based data. This view is supported by researchers in organizational information processing, who have found those organizations facing higher levels of uncertainty and dynamism (Leblebici and Salancick, 1981) or complexity (Campbell, 1988; Culnan, 1983) process more information.

METHODS

Research Sites

Data were collected at five grocery manufacturers. They were selected because each developed and implemented their marketing programs with national product management organizations. The companies varied in size from under $100 million to over $1 billion in sales. Table 1 contains summary information about each company, including how it was organized, how many people were interviewed, and how many products were studied. Contact was made through senior marketing or general management. Within each company, senior managers were asked to select work units that varied in use of computer-based data.

Our unit of analysis was a product management work unit. Each of these work units was responsible for marketing a product line or a segment of a product line. The units consisted of a single product manager or several product managers of varying ranks. Product managers[2] were responsible for developing marketing programs (e.g., consumer promotions) for a particular product line (e.g., Skippy Peanut Butter), which were then implemented by the sales force. They set prices, planned marketing activities, introduced new varieties, and monitored competition. They typically reported to the vice president of marketing. Product managers performed highly similar functions both within and across companies (Quelch, Farris, and Olver 1987).

The products themselves varied in age, sales volume, market share, and growth rate They ranged from 1 to over 100 years old and from under $50 million to over $500 million in sales. About as many were increasing as were decreasing in market share. Most products were growing in sales, with an average growth rate of under 5% per year. Maximum growth was about 20% per year. Summary information on the products included in the study can be found in Table 2.

The product managers were mostly in their 20s or 30s. All had undergraduate and many had M.B.A. degrees. They typically started their careers as assistant product managers, responsible for data analysis and implementing marketing programs. As their experience increased, they became responsible for designing promotions, adjusting price, monitoring distribution, and introducing new varieties. Product managers were accountable for the "health" and performance of a brand (Quelch, Farris, and Olver 1987). They were supported by a market research function and worked closely with sales, research and development, and production managers. Product managers were evaluated based on their products' performance, typically measured in sales or market share. Product management was viewed as a first-step (and sometimes a fast-track) to senior general management.

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2 For sake of brevity and clarity we will use the phrase "product managers" when referring to product management work units.

TABLE 1: DESCRIPTION OF COMPANIES INCLUDED IN THIS STUDY

Company	Description	# of products included/total studied	interviewees
Young's	major manufacturer (over $1 billion sales); leader with few large competitors in most categories; growth varies by category; bureaucratic culture	6/12	14 PMs, 5 marketing support, 3 MIS
Country Fresh	major manufacturer (over $1 billion sales); leader with few large competitors; slow growth; bureaucratic culture	2/4	6 PMs, 9 marketing support and IS (groups were combined)
Butler	smaller ($200 million sales) subsidiary of major manufacturer; run independently; leader in most product categories; growth varies by category; entrepreneurial culture	5/7	8 PMs, 6 marketing support; 3 MIS
Gamma	small (under $100 million sales) privately-held; competition from large firms -- follower; slow growth; numbers-oriented culture	2/2	2 PMs, VP marketing, MIS manager
Luigi	small (under $100 million sales) subsidiary of major manufacturer; run independently; leader in category; rapid growth; entrepreneurial culture	1/1	2 PMs, president, and MIS manager

TABLE 2: DESCRIPTION OF PRODUCTS INCLUDED IN THE STUDY[3]

Company	Product	sales $MM	market share	market position	growth (%/yr)	no. of varieties	age in yrs	no. of of informants
Young's	Santa Fe Chili	175	27	#2	8	20	7	4
	Mom's frozen waffles	50	10	#3	-5	6	20	2
	Mustard	300	60*	#1	0	40	30	3
	Ketchup	600+	80	#1	0	50	50+	2
	Tomato Paste	90	20	#2	-6	6	50+	2
	Tres Chic Ice Cream	50	90	#1	20+	4	2	2
Country Fresh	Orange Juice	300	35	#1	0	20	50+	3
	Grapefruit Juice	150	50	#1	0	12	20	4
Butler	frozen pizza	20	15	#2	15+	6	2	5
	diet dinners	60	90*	#1	-20	11	5	3
	french toast sticks	5	80*	#1	N/A	3	<1	3
	fish sticks	30	95*	#1	-5	2	30	2
	gourmet dinners	3	15*	#2	-20	5	2	2
Gamma	Jellies	20	10	#4	8	4	15	3
	Chutney	5	<5	#25	10+	1	3	3
Luigi	frozen pizza	100	70	#1	15+	12+	50+	3

*These product managers defined their competitors rather narrowly . Their share and position would be lower using product categories defined by Nielsen or Information Resources.

[3] Fictituos products were created to capture many of the characteristics of the true product. For example, the product disguised as Santa Fe Chili is an ethnic product in a mature category with large regional differences in consumption. All figures are approximate

INFORMANTS

Multiple informants were used to collect data on each work unit. These included assistant and associate product managers, product managers, and their superiors (director or vice president of marketing). Product managers typically discussed their own unit and compared it to others within the company, and occasionally to units at other companies. These managers were knowledgeable about other units through several mechanisms. Since product managers typically change jobs every few years, many of these managers had previously worked for other units that were part of the study. In addition, product managers from several work units often worked together to develop joint marketing programs or to solve problems that were common across products. Vice presidents of marketing also discussed the several units under their supervision and sometimes others within the company with which they were familiar. Some of the one-third of product managers and their superiors who had experience at other grocery manufacturers compared their units and their company to units with which they were familiar at their previous employer.

Informants were each interviewed for approximately one hour, guided by a semi-structured interview protocol to provide consistency, yet allow for free response (see Appendix). They were questioned about their background, their work, the characteristics of their product and its marketing environment, and their use of computer-based data. Data for this study came from responses to four questions. The questions on their education and work history and their product (Questions II and III) provided background for our analysis and important information on potential factors that influenced use of computer-based data. Question IV provided data on actual use of computer-based data. In addition, product managers were directly asked to identify factors that influenced their use of computer-based data (Question VII).

Interviews were also conducted with information providers — members of the MIS, market research, and marketing or sales analysis or support groups who supplied information or technical support to product managers. These informants provided background on the type of data and analytic tools used by product managers.

Data Analysis

All interviews were conducted by the first author. Each interview was taped and the tapes were transcribed. The author combined the transcriptions with his field notes to develop a data base of factors that affected the use of computer-based data for each person interviewed. This data base contained a description of the product and its marketing environment, the manager and her background, the manager's use of computer-based data, the factors explicitly identified by the manager as affecting her use of computer-based data, and any comparisons that she made with other people, products, or organizations.

Both authors reviewed the data base and transcripts for all 32 informants and 28 work units. We developed a preliminary idea of differences in use of computer-based data among the products and a preliminary set of factors that were viewed as key determinants of use of computer-based data by product managers.

In subsequent analyses and in the presentation of our results, we will consider only those products that were discussed by more than one informant. This reduced our sample to the 16 work units whose characteristics are presented in Table 2. Restricting our analysis to these work units allow us to increase the reliability of our results.

The next step in our analysis was inducing propositions using procedures for building theories from qualitative data outlined by Eisenhardt (1989b). For this step, we selected only products that were discussed by more than one informant. We first selected pairs of products for which product managers made explicit comparisons. These comparisons often involved their own product and a product that they perceived used a great deal or not very much computer-based data. The managers were very reliable in identifying these high use and low use products. Using these pairwise comparisons served two purposes. First, we were able to select high use and low use of computer-based data and define and operationalize this construct for product management work units. Second, we could develop lists of similarities and differences among high and low use products. From these comparisons, we developed a preliminary set of propositions.

We then reviewed existing literature to translate insights presented by marketing managers into the language of MIS and organizational behavior research. The product managers identified marketing specific factors, such as the presence of several competitors, as affecting the use of computer-based data. A review of the organizational information processing literature helped classify this factor as an example of a relatively complex marketing environment. This review produced a revised set of hypotheses that were both empirically and theoretically grounded. We then tested and refined these hypotheses with a detailed review of the data base and the transcripts. This was an iterative process involving several revisions of the propositions and several detailed data base reviews.

There were three results of our analytic process. First, we produced a classification of product management work units based on their use of computer-based data. Second, we developed a set of propositions that relate characteristics of the business environment to data use. Finally, we developed a categorization scheme for products based on the inter-relationships among the characteristics of the business environment. While our results fit the evidence about variation in use of computer-based data among the products, the fit is not perfect, as is common in both quantitative and qualitative research (Eisenhardt, 1989a).

RESULTS

Differences in the Use of Computer-Based Data Among Products

The use of computer-based data is defined as the gathering, analysis, and interpretation of data generated by information systems[4]. The data could be used to monitor the environment, tracking trends in performance or in variables that influence performance. Alternatively, managers could analyze data to respond to a specific threat or opportunity (elSawy, 1985).

Product managers in our sample analyzed computer-based data from many sources including data produced by their firms on sales, shipments, and inventory. These internal data were supplemented by purchased data on market share, price, and promotional activity for all products in a specific category (e.g., all orange juice brands sold in the U.S.). Internal data were typically available daily or weekly and purchased data were available monthly. Approximately 20% of the product managers entered these data into personal computers and analyzed them using spreadsheet software. Less than 10% used marketing decision support systems that were available at three of the five companies.

Product managers noted that computer-based data was one of several sources of information that they used. They also relied on in-store observations, discussions with the sales force, market research reports, and trade and consumer periodicals. These other sources, however, were uniformly perceived as less important than computer-based data.

The managers noted that computer-based data played a critical role in their work, confirming findings of McCann (1986). External data on market share was used as a 'report card' to evaluate a product's performance. One product manager discussed the arrival of monthly market share report:

> *The data is hand-delivered to the president [of the subsidiary], the executive vice president, the director of marketing, and the product managers. It arrives at 10 A.M. on a Tuesday. People wait for the mail person. It's pretty intense.*

> *The managers tend to look at market share for the total U.S. and for a few key markets. I often get notes from them asking, 'why did this happen? what's going on?' It's my job to know that our Denver numbers are off, because our competitor ran a coupon. By 2 P.M. that day, a report is on the desk of the division president at corporate. It contains market share data plus trends for the year.*

Table 3, which is ordered from high to low use, summarizes how product managers employed computer-based data. Managers who used a great deal of data, quite simply, analyzed more variables, in more detail, more often. The variables the managers considered were those on

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[4] Based on the definition of information processing activity developed by Daft and MacIntosh (1981).

which they were measured — market share and sales — and those variables that influenced share and sales. The latter can be summarized by the 4Ps of marketing — price, product (e.g., varieties or flavors), promotions (both consumer and trade or supermarket), and place (e.g., distribution by region). These variables were examined in more detail when more regions, competitors, or varieties were analyzed. Further, the variables were analyzed more often when they were studied weekly or monthly rather than quarterly or annually.

To simplify our analysis, we will divide the products into three groups — high, moderate, and low use of computer-based data. Country Fresh Orange Juice typifies a high use product. The orange juice product managers analyzed a great deal of quantitative data to monitor the impact of pricing decisions. For the three largest supermarkets in each region, they monitored weekly advertising, including price and ad size, for each Country Fresh variety and its seven largest competitors in that region. They also monitored shipments and orders by region for major accounts weekly, and market share for Country Fresh and all major competitors by region monthly. Their analyses were used to identify potential problems, to adjust prices and promotions in response to competitor actions, and to develop new marketing programs.

In contrast to its orange juice, Country Fresh Grapefruit Juice fits into the moderate use category. The main difference in use of computer-based data between the two juices was in frequency of analysis. While the grapefruit juice product manager received weekly reports on pricing and trade promotions, she analyzed them either when a major problem was identified or after a major promotion was completed. Otherwise, a quarterly analysis was performed to study the impact of changes in pricing, trade promotions, and coupon activity on market share for Country Fresh and its major competitors by region. As with Orange Juice, the analysis was used to adjust prices and to develop marketing programs.

Young's Ketchup provides an example of a low data use product. National data on market share and sales volume were reported monthly, but little analysis was performed on these data. The product manager focused her attention on trade promotions. If a new promotion was tested in a particular region, she examined its impact on shipment and sales volume data. In contrast to the two juice products, little attention was paid to competition and competitor actions, to regional differences in sales or price, or to trends in sales by variety.

TABLE 3: USE OF COMPUTER-BASED DATA BY EACH PRODUCT MANAGEMENT WORK UNIT

product	sales	competition	price and promotions	overall
Country Fresh Orange Juice	track shipments and orders by region for major accounts weekly	track market share for product and all major competitors by region monthly	track weekly advertising, including price and ad size, for each variety and 7 competitors in the three largest supermarkets in each region	"they study every detail in every part of the country"
Young's Santa Fe Chili	track by region and variety weekly to assess sales and impact of promotions. "It's our first indication that something is wrong."	track monthly changes in wholesale prices, sales volume and market share for product and national competitor by region by variety examine impact of consumer promotions by region		detailed yearly analysis of performance "there's so much money out there against the business. If I'm not on top of it, it'll go to hell in a hand basket real quickly."
Luigi's frozen pizza	track daily for nation to get "basic pulse of the business" track weekly by region and variety;	track share monthly for Butler and Luigi by variety by region with extra focus on new products in test market	weekly spot check regions with heavy promotions and new varieties track coupon redemption by region	"constant evaluation of how our activities and our competitor's influence our results."
Butler's frozen pizza	track weekly	track share monthly for Bulter and Luigi in nation and competitive versus non-competitive regions	track coupon redemption in key regions analyze previous promotions by region to develop plan for next year	just completed major product review of share, price, promotion trends for Luigi and Butler by region and variety, look for regions with low brand sales and high category sales to target
Young's Mom's frozen waffles	review shipments and orders daily	track market share, distribution, and price monthly by region for product and major competitors		just completed major review of pricing, promotions, distribution, and sales by variety and region for product and competitors
Country Fresh Grapefruit Juice	track price and promotions weekly	analyze competition quarterly or when major problem found	analyze share, price, promotions, and coupon activity by region and variety quarterly or when major promotion completed or major problem found	"we may not do an in-depth analysis every month, but we'll certainly do it every quarter"
Butler's Diet Dinners	track monthly sales and market share by region and variety for product and one competitor	track competitor sales in test markets for new products	focus on problems of distribution as some varieties are declining in sales	compare monthly sales to previous year by variety for product and competitor to see "what's happenning with the product as a whole and with the varieties"
Gamma Jellies	track sales by region and variety monthly	not mentioned	assess impact of promotions quartetly	track roll out of new variety and its cannibalization of existing varieties

Butler's Gourmet Dinners	track market share and shipments monthly for nation for product and one competitor	not mentioned	monitor impact of promotions and competitor action quartetly or when major problem found	not mentioned
Butler's French Toast Sticks	track distribution and shipments by flavor by account weekly to identify which accounts are taking product	not mentioned	not mentioned	not mentioned
Young's Mustard	monitor sales by variety by region monthly	not mentioned	"very little time" spent evaluating promotions — only at national level	more in-depth analysis for specific varieties by region in reaction to problem or in yearly brand review
Butler's Fish Sticks	track market share and shipments monthly for nation	not mentioned	examine impact of quarterly promotion for nation	no periodic overall review of brand performance "not enough time to do analysis"
Gamma Chutney	monitor sales monthly by region and when problem found examine distribution by account	not mentioned	assess impact of promotions at national level yearly	not mentioned
Young's Ketchup	little analysis done of monthly report on market share and sales for nation	not mentioned	minimal analysis (yearly) of impact of promotions on shipments and sales volume at national level, regional level analysis only on exception basis	"Do [managers for ketchup] feel under a great deal of pressure to analyze [computer-based data]? Probably not "
Young's Tomato Paste	monitor shipments and orders daily	minimal analysis of sales and share by region monthly for product and competitors	not mentioned	"I honestly don't get much time to go through the numbers. I do it only when there's a problem or a request to give an update on the business"
Young's Tres Chic ice cream	national data on sales and shipments by variety to track trends and sales of new products	not mentioned	not mentioned	no market share data purchased

TABLE 4: OTHER FACTORS THAT INFLUENCED MANAGERS' USE OF COMPUTER-BASED DATA

factor	example
product managers' computer skill	"I'm not an experienced computer user."
the view of their superiors about data analysis	"My manager is not numbers-oriented, that's part of his style — the way he approaches the business."
the culture of the company	"We're a family-owned company and the family is happy with the amount of money we're making, so there's not a great deal of pressure to analyze data " "At [previous employer] people were too focused on information You spend so much time analyzing data, no one was willing to take actions ."
importance of product to company	"Cheweez is our flagship brand. It's the most important brand to the company." [Presented as a reason why more analysis was done on this brand.]
the availability of data	"It's more difficult to find information here. [Previous employer's] cataloging of information and its system for bringing it out is better."

Since product managers used computer-based data to monitor the marketing environment, it is not surprising that they identified characteristics of this environment as the factors that most influenced their use of these data. The managers focused on the impact of elements such as the intensity of competition and the newness of their product when describing determinants of their use of computer-based data. All product managers discussed the marketing environment in response to our question about factors that influenced their use of computer-based data and most mentioned several environmental characteristics. A few managers also mentioned other influences, which are summarized in Table 4. Even these managers stressed the relative importance of environmental characteristics over these other factors. In the following sections, we will present four propositions that relate environment and use of computer-based data.

Complexity and the Use of Computer-Based Data

The data from this study indicate that the complexity of the environment faced by product managers affects the degree to which these managers use computer-based data, which confirms findings by several other researchers (Leblebici and Salancick, 1981; Culnan, 1983). A complex environment is one in which there are more variables and more interactions among variables (Simon, 1969). For marketing managers, the relevant variables are ones that influence their performance — those that affect sales, market share or profits.

> ***Proposition 1: Product managers will use more computer-based data when the marketing environment is more complex.***

Product managers were classified as facing a relatively complex environment, if there were many competitors, many product varieties, or strong regional variation in sales. In addition, some environments were more complex, because of an interaction among factors. For example, there could be differences in competitor strength, price, or promotions by region. The complexity of the environment faced by the products is summarized in Table 5.

Young's Santa Fe Chili faced a very complex environment. There was one strong and several weaker national competitors. There were also several competitors only in the Southwest region — the area with the greatest chili sales. In addition, there were many varieties of Santa Fe Chili and several flavors and sizes within each variety. The assistant product manager commented on the complexity of the product's environment:

> *You have these competitive brands that are just in the Southwest. They have all their budget there, whereas we've got to spread our budget nationally. So we find that you really have to be more regionally oriented in marketing towards the Southwest. It's almost like two different tactics. You have the Southwest and then the rest of the country. There's a lot of opportunity in the rest of the country, because there are only two brands out there. So we try not to ignore that either.*

In response to this complexity, the Chili product managers analyzed more computer-based data.

They tracked sales, market share, price, and marketing activities for both their national and regional competition. They also tracked shipments of their product weekly to assess the impact of their promotions

Luigi's frozen pizza faced a moderately complex environment. Like chili, pizza was an ethnic product with strong regional differences in product sales, adding to the complexity of its environment. Unlike chili, Luigi's had one major national competitor, no strong regional competitors, and only about a dozen varieties in one product line. The Luigi's pizza product manager commented on the relationship between complexity and use of computer-based data by contrasting the needs of Luigi's with Country Fresh — his previous employer:

> *I would say that I probably have less need here than at Country Fresh, because of the market situation. In our marketplace, there are only two main competitors, although we have some local and regional competitors. When you have a category that is cluttered with 5 or 6 competitors, that has some real regional skews — you might even have product differences in different regions — you need more information.*
>
> *We have our eye on one guy, basically. We look at the local guys, but no matter what they do, they don't have the bucks to spend against us. They might go up or down a point or two, but basically they're under control.*
>
> *When you have 3-4 major competitors, you need faster information, because you're watching not only a frontal assault, but you're watching your flanks and you're watching the sky and below.*

The least complex marketing environment was faced by Gamma's Chutney product manager. His product was available in only some parts of the country, faced no competition, and came in only one variety. In response to this relatively simple environment, the product manager analyzed very little data. He examined data on the degree to which supermarket chains stocked Chutney. He did not examine data on pricing, competition, or promotions.

Dynamism and the Use of Computer-Based Data

Dynamism is the second factor identified as influencing product managers' use of computer-based data, confirming results of Leblebici and Salancick (1981). A dynamic environment would be one in which there were frequent changes (Duncan, 1972) in variables that influence marketing performance. Children's toys, for example, would be more dynamic than men's hosiery.

> ***Proposition 2: Product managers will use more computer-based data when the marketing environment is more dynamic.***

TABLE 5: ANALYSIS OF COMPLEXITY OF PRODUCT ENVIRONMENTS

product	level	competition	regional differences in sales or share	varieties and sizes
Country Fresh Orange Juice	HIGH	one strong national and several regional competitors	regional variation in package size and varieties	about 6 varieties and 4 sizes
Young's Santa Fe Chili	HIGH	one strong national and several regional competitors	regional variation in package size and varieties	3 lines with 2-3 varieties and 3 sizes
Luigi's frozen pizza	HIGH	three strong national competitors	regional variation in competitive strength	about 3 varieties and 2 sizes
Butler's frozen pizza	MOD-ERATE	one major competitor	sales strongly regionally skewed and promotions tailored to regional differences	about one dozen varieties sold in Midwest and four in rest of country. "I look at specific flavors. How is pepperoni doing?"
Young's Mom's frozen waffles	MOD-ERATE	one major competitor. "Competition is a factor [in my use of data] Luigi's is five times my size."	"pizza is more regional and we use more regional information." "Chicago makes up about 25% of my business. I look at how we're doing over the last 4 and 12 wks in Chicago compared to the rest of the country."	about 8 varieties available in Midwest, 2-3 in rest of country
Country Fresh Grapefruit Juice	MOD-ERATE	two strong national, but weak regional competitors	not mentioned	about 3 varieties and 4 sizes
Butler's Diet Dinners	MOD-ERATE	one national competitor	regional differences in distribution	11 varieties. "I look at all the detail for a given market. How is pasta vs. chicken vs. fish? I want to see where I'm marketing what."
Gamma Jellies	MOD-ERATE	one national in test market and several indirect competitors. "The more direct the competitor, the more information I need"	"strong regional differences in sales"	4 varieties
Butler's Gourmet Dinners	MOD-ERATE	one strong national competitor	not mentioned	5 varieties

Butler's French Toast Sticks	MOD-ERATE	small regional competition with major competitor in test market	not mentioned	3 varieties
Young's Mustard	MOD-ERATE	one national; 1/3 product's sales	"treated very much as a national business"	about 20 varieties and two sizes
Butler's Fish Sticks	LOW	only small regional competition	not mentioned	2 varieties
Gamma Chutney	LOW	no competition	only available in 50% of country. "More data is needed on brands with national distribution "	"It's a simple brand with 1 SKU [variety]"
Young's Ketchup	MOD-ERATE	two smaller national competitors	little difference in consupmtion by region	over 50 varieties in four lines
Young's Tomato Paste	MOD-ERATE	one national competitor — not viewed as major threat.	each competitor 'owns' certain regions, which limits competition. "It's been very difficult for either of us to make inroads into the areas where the other is stong."	6 varieties
Young's Tres Chic ice cream	LOW	no competition	not mentioned	4 varieties

TABLE 6: ANALYSIS OF DYNAMISM OF PRODUCT ENVIRONMENTS

product	level	changes in price or promotion	new varieties
Country Fresh Orange Juice	HIGH	daily adjustments in price by account for product and main competitor — "If I'm off a dime it could hurt my business"	flavor changes infrequent
Young's Santa Fe Chili	HIGH	weekly price adjustments and trade promotions by region by Santa Fe and competitors — "very, very promotiion and price sensitive category" "share and price are always changing"	frequent changes in flavors to match consumer taste trends
Luigi's frozen pizza	MOD-ERATE	adjustments in price and promotion spending by region to match competition	flavor changes infrequent
Butler's frozen pizza	MOD-ERATE	frequent adjustments in price and promotion spending by region to match competition and supermarket's needs	few (1-2) new varieties added per year
Young's Mom's frozen waffles	MOD-ERATE	adjustments in price and promotion spending by region to match competition	several new varieties added per year analysis conducted of success of competitor's new varieties
Country Fresh Grapefruit Juice	MOD-ERATE	adjustments in price or trade promotions only in reaction to problem	
Butler's Diet Dinners	MOD-ERATE	few price adjustments	fad product that has past peak with too many varieties "Butler has just introduced 15 new varieties [in other products] and some of my varieties have been swapped out. I need to find out which ones."
Gamma Jellies	LOW	few price adjustments; quarterly promotions	no new varieties
Butler's Gourmet Dinners	LOW	few adjustments to price	few changes in varieties
Butler's French Toast Sticks	MOD-ERATE	few adjustments to price	some new varieties being tested
Young's Mustard	MOD-ERATE	few adjustments to price	several new varieities per year; their introduction important to sales
Butler's Fish Sticks	LOW	older brand with few changes in price or promotion	no recent introductions of new varieties

Gamma Chutney	LOW	few adjustments to price	one variety; no new ones planned
Young's Ketchup	MOD-ERATE	older brand that changes marketing programs only 1-2 times per decade	several (4-6) new varieties introduced each year
Young's Tomato Paste	LOW	older brand with few changes the category is pretty well set. There's not a lot of new activities."	no new varieties
Young's Tres Chic ice cream	HIGH		fad product with many new varieties

Product managers identified several factors that made an environment more dynamic. There could be frequent price changes or many promotions carried out by the product manager and her competitors. Alternatively, there could be frequent introductions of new varieties or flavors by some or all the competitors. Differences in dynamism among the products are summarized in Table 6.

Country Fresh Orange Juice and Young's Santa Fe Chili faced very dynamic environments. Product managers for both brands monitored and adjusted prices daily in reaction to competitor actions. The Country Fresh product manager noted that his product was very price sensitive. Consumers were not brand loyal. If his price were too high, he would lose sales. He stated, "If I'm off a dime, it could hurt my business." In addition, the Chili product manager closely monitored the frequent introduction of new varieties by her company and its competition.

Both products also were promoted several times each quarter. The product manager for Country Fresh Orange Juice discussed the impact of frequent promotions, by comparing his product with Grapefruit Juice:

> *You won't see as many features [deals with supermarkets] on Grapefruit Juice. They're lucky if they get one a quarter. I get 3 or 4 a quarter. So they have a lot more time to get competitive information, worry about it, and react to it.*

Products that faced moderately complex environments, like Grapefruit Juice, typically promoted their products quarterly and adjusted prices based on a quarterly analysis or in reaction to a major change (e.g., a competitor action or a change in supplier price). Product managers for these less dynamic products analyzed computer-based data less often, relying on monthly status checks and quarterly reviews, rather than daily status checks and constant adjustments in marketing programs.

Some of the moderately dynamic products faced an environment in which there were several new varieties introduced in a year by their company and its competitors. The product managers closely tracked these introductions to spot trends in the market. They followed the varieties in their test markets, which involved monthly checks of purchased data on market share, sales, and price.

Other products faced a very static environment, with few changes in price, few promotions, and few new varieties. Many of these products were older and were in mature product categories. The product manager for Young's Tomato Paste noted that, "The category is pretty well set. There's not a lot of new activities." In reaction, he performed little analysis of computer-based data. He stated, "I honestly don't get much time to go through the numbers." Managing this brand, which was relatively large compared to others in our study, was only a part-time job for this product manager. He also spent his time developing a new product in a related

category.

Uncertainty and the Use of Computer-Based Data

Managers face an uncertain environment when they cannot predict the impact of external events (Milliken, 1987)[5]. This uncertainty will lead them to gather and analyze more data.

> ***Proposition 3: Levels of complexity and dynamism being equal, product managers will increase their use of computer-based data in response to an increase in environmental uncertainty.***

The relationship between uncertainty and use of computer-based data is slightly different from the relationship between complexity and dynamism and the data use. Major environmental changes led to increased uncertainty and caused product managers to gather specific data to respond to these changes. There were several sources of uncertainty. If the product manager, managed a new product, he was concerned first about gaining distribution to determine whether the product was a success. Further, he wanted to determine the factors that influenced product sales. If the product manager faced a new competitor, he wanted to track it closely to determine whether it was a threat (e.g., was it gaining distribution?) and to understand what marketing tactics its managers were employing. He wanted to know how to alter his pricing and promotion strategy and his regional distribution of funds to minimize the impact of the new entrant. Table 7 summarizes the level of uncertainty faced by the product managers and how the managers analyzed computer-based data to reduce it.

The approach product managers took to respond to an uncertain environment can be illustrated by examining the two main competitors in the frozen pizza category — Luigi's and Butler's. Luigi's was a single product company and had been selling frozen pizza for over twenty years. Before the entry of Butler's, it was the only national brand, controlling over 90% of the market.

Butler's entered the frozen pizza category, which was growing at over 15% per year — about two years before these data were collected. Until that time, all of Butler's products were in other frozen categories, they faced little competition, and most had flat or declining sales. Butler's Pizza, in contrast, faced stiff competition from Luigi's and was projected to grow rapidly. Butler's made a strong initial thrust into the market, but its share had stabilized at under 20%.

Analysis of computer-based data at Butler's mostly involved comparing its product with Luigi's. The product managers analyzed market share data monthly focusing on the Northeast, where frozen pizza sales were strongest. They grouped regions with similar sales patterns and

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[5] We are using Milliken's definition of effect uncertainty. The traditional definition of uncertainity – lack of information about the environment is too broad. It subsumes both dynamism and complexity.

conducted analyses using these groupings, examining trends in market share and sales. They tracked shipments weekly to measure changes in distribution. Further, at the time these data were collected, the product managers had just completed a major product review. They examined market share, price, promotion, and sales volume trends by region by variety for Butler's and Luigi's. They were attempting to determine how to differentiate their product from its competitor.

Managers were trying to adjust the marketing mix to increase share. The pizza product manager noted:

> *We want a promotion for the first quarter and we want to center it in the Northwest [a traditionally strong area for Butler's]. We think a direct mail piece would be very effective, but we don't have a lot of data to tell us that direct mail is the way to go. Is using a coupon in Seattle and a direct mail piece in Boise a good strategy, or is trade dollars in Portland more effective? We don't have a lot of history.*

> *It's difficult to plan any promotions outside the Northwest. We need to know the hot buttons to get people to buy Butler's. What works well where? A fundamental question is: We've been in the business for a year and we've not been that effective in driving our business. Are we wasting our money?*

Luigi's also faced an uncertain environment caused by the entry of their first major national competitor. The product managers closely examined monthly sales and market share data for Luigi's and Butler's by region and by variety. They focused on regions where Butler's was strongest and those where it carried out a marketing program. Product managers used this data to adjust their marketing mix to account for any changes made by Butler's.

A senior marketing manager noted:

> *I need to learn more about Butler's and how serious a threat it might be. When it entered, we produced our first statistics on how well we and it were doing — household penetration, buying rates, consumer loyalty, average purchase price, and per cent sold on deal.*

The Butler product manager for frozen fish sticks compared her product to frozen pizza. She noted that the environment she faced was much more certain (and less dynamic and less complex):

> *I don't use much information on fish sticks, because my products are so old. They've been around for so long, most of them, that there isn't much news on them. They don't have a lot of competition. It's not like pizza where what Luigi's is doing so impacts what our business does*

Analyzability and the Use of Computer-Based Data

Analyzability is the fourth factor identified as influencing product managers' use of computer-based data. An environment is highly analyzable if managers can learn about it through "intelligence gathering, rational analysis, vigilance, and accurate measurement (Daft and Weick, 1984, p. 287)." This is an environment where both the variables upon which the managers are evaluated and the factors that influence these variables are easily measured. In related research, Culnan (1983) found that managers used more data when it was more accessible to them.

> ***Proposition 4: Analyzability of the marketing environment is a necessary, but not sufficient condition for use of computer-based data by product managers.***

Three product managers noted that they did not analyze much computer-based data, because the factors that influenced the performance of their products were not captured by these data. Two of these product managers relied on advertising to increase sales. The third used consumer observation to spot new flavor opportunities. The product manager for Country Fresh Grapefruit Juice commented on her use of advertising and its impact on the degree to which she analyzed computer-based data by comparing her product to Orange Juice:

> *[Grapefruit Juice] is very advertising-driven and advertising is national. It's more long-term. There's not a lot of short-term regional types of data that you would be looking at. Everyday you can't look and say 'Grapefruit Juice is doing great or doing bad,' whereas Orange Juice's kind of program will show up in two weeks. If the promotion worked, it'll be there [in the data].*

The product manager for Young's Ketchup also relied on advertising. The product was the category leader with over 70% market share and no significant competition. The approach he and his predecessors took to marketing was to use advertising to increase total Ketchup sales — "to grow the category." As with Grapefruit Juice, this approach did not lend itself to frequent or detailed analysis of computer-based data.

The product manager for Young's Tres Chic super-premium ice cream also faced a relatively unanalyzable environment. Spotting flavor trends and identifying potential new Tres Chic flavors was critical for the success of the product manager. Toward that end, he spent a great deal of time at ice cream parlors, watching what people of different ages were ordering in different parts of the country. While he did track the performance of his new flavors, he spent relatively little time analyzing quantitative marketing data when compared to the time he spent visiting ice cream parlors.

TABLE 7: ANALYSIS OF UNCERTAINTY OF PRODUCT ENVIRONMENTS

product	level	rationale	example of related computer-based data use
Country Fresh Orange Juice	LOW	established brand with few new competitors	
Young's Santa Fe Chili	MODERATE	established brand, several new regional and national competitors	track new entrants to determine if threat
Luigi's frozen pizza	HIGH	new (and first) major national competitor	learn about Butler by gathering stats on both it and own product
Butler's frozen pizza	HIGH	new product for Butler and first time in product category "Pizza is separate from other Butler products." " This is the first time we've gone head-to-head with a competitor"	"learn 'hot buttons' to get consumers to buy Butler's" by studying impact of price, promotions
Young's Mom's frozen waffles	LOW	established product with few new competitors	
Country Fresh Grapefruit Juice	LOW	established product with few new competitors	
Butler's Diet Dinners	MODERATE	new (first) competitor considering entering market	track competitors sales in test markets
Gamma Jellies	MODERATE	new national competitor in test market	A competitor introducing new products is a red flag that we'll follow."
Butler's Gourmet Dinners	MODERATE	new product for Butler, facing established national competitor	"It's a new product. I'm watching share closely, because I don't know what normal volume is. Is it s product that responds well to trade promotions?"
Butler's French Toast Sticks	HIGH	new product rolling out after successful test market	distribution data used to track which supermarkets stock which varieties
Young's Mustard	MODERATE	established product, losing share to growing national competitor	"For years this company owned the category. We didn't do a lot of analysis, because there was no competition That's now changing"

Butler's Fish Sticks	LOW	established product with few new competitors "it's been around for 30 years and is pretty predictable."	"I don't use much information, because my products are so old They've been around for so long, most of them, that there isn't much news on them "
Gamma Chutney	MODERATE	new product slowly rolling out nationally	track which accounts to target based on Jellies sales
Young's Ketchup	LOW	established product with few new competitors	
Young's Tomato Paste	LOW	established product with few new competitors	
Young's Tres Chic ice cream	HIGH	fad product with many new varieties	relies on qualitative data — visits to ice cream parlors — to determine new flavors to introduce tracks sales of new products his focus is on 'home runs' (new products) not singles (improving sales on existing products)

TABLE 8: CONFIGURATIONS OF ENVIRONMENT, MARKETING MIX AND USE OF COMPUTER-BASED DATA

	Configuration 1: Responsive	Configuration 2: New Player	Configuration 3: Traditional
Environment	- high complexity from multiple competitors and regional differences - high dynamism from frequent changes in price and promotions - high analyzability from price oriented marketing strategy	- high uncertainty from newness of product or entrance of new competitor	- low to moderate complexity from limited regional differences - low dynamism from few product changes - low uncertainty from few new products or competitors
Marketing mix	marketing mix based on regional price adjustments and trade promotions	adjust mix to gain share for new products or to maintain share for new competitor	national advertising and promotions
Use of Computer-Based Data	high, monitor and analyze sales and market share weekly, by region	moderate to high, assess impact of changes	low, quarterly analysis of national sales and market share
Examples (fictitious)	Santa Fe Chili, Country Fresh Orange Juice, Mom's Frozen Waffles	Butler's and Luigi's frozen pizza, Tres Chic ice cream	Young's Ketchup and Tomato Paste

A Categorization of Product Environments

There are some inter-relationships among the four factors that affect use of computer-based data among product managers. In addition, these factors and the use of computer-based data are both related to the marketing mix employed by the product managers. Three configurations can be used to explain these links and to classify the environments faced by the product managers. The concept of the configuration allows us to focus on the few highly meaningful contingencies (Miller, 1986) that substantially explain use of computer-based data. Table 8 summarizes presents these configurations.

The responsive configuration was characterized by an environment with high complexity stemming from multiple competitors and regional differences in consumption and competition and high dynamism caused by frequent changes in price and promotions. In response to this environment, product managers instituted a marketing mix that relied heavily on regional price adjustments and trade promotions. Hence, use of computer-based data played a critical role for product manager facing a responsive environment. Managers analyzed sales and market share by region on at least a monthly basis for their product and its major competitors. This detailed monitoring was needed to react to the rapid changes in the environment. Country Fresh Orange Juice, Young's Santa Fe Chili, and Mom's Frozen Waffles are examples of products facing responsive environments.

The second configuration is characterized by an environment with high uncertainty. This uncertainty is caused by the product itself being new or by a major competitor entering the market. Marketing mix focuses on gaining or maintaining distribution and on developing a pricing and promotion strategy. Use of computer-based data is moderate to high. Product managers analyze data to assess the viability of the new player and its impact on the category. Butler's Frozen Pizza, Diet Dinners, French Toast Sticks and Gourmet Dinners, Luigi's Frozen Pizza, and Gamma's Jellies are examples of products facing new player environments.

Two types of products fall into the traditional configuration — older, stable, low growth ones and smaller products with limited marketing budgets. This configuration is characterized by low uncertainty stemming from few new products or competitors, low to moderate complexity stemming from limited regional differences in sales or competition, and low dynamism stemming from few product changes. The marketing mix for traditional products was predominantly national and relied relatively more on advertising and less on trade promotions and price reductions (sometimes leading to low analyzability). Use of computer-based data was relatively low. Managers focused on national results, often examining them only quarterly.

DISCUSSION

There are three principal conclusions from this study. First, analysis of computer-based data plays a critical role in product management. This is an encouraging result for MIS researchers, who are often asked to justify the importance of information technologies. Second, the level and type of analysis performed varies greatly by product. While this is an intuitive finding, it is often not considered by either MIS researchers or managers. For example, when these results were presented to the MIS managers at the participating organizations, all were surprised at the variation in use of computer-based data among managers who performed similar tasks. Third, variation in data use can be explained by differences in the environment faced by product managers. This finding points out the importance of considering organizational context in studies of factors affecting the use of information technology.

Specifically, we found that four environmental characteristics — complexity, dynamism, uncertainty, and analyzability — and the interactions among them affect the degree to which product managers use computer-based data. High levels of complexity in the product manager's environment stemming from strong competition, strong regional differences in competition or consumption, or multiple product varieties, were all identified as determinants of increased use of computer-based data. Of these, level of competition was most strongly related to use of computer-based data. For example, product managers for both Young's Chili and Country Fresh's Orange Juice focused most closely on monitoring competition and reacting to it. Further, products with many varieties and little competition, like Young's Ketchup, were not as likely to have product managers who carried out a great deal of analysis. The product manager for Luigi's Frozen Pizza identified the introduction of a new competitor as the principal driver of a major increase in use of computer-based data. He noted that his data use would be even greater if more competitors entered the market.

Dynamism, caused primarily by rapidly changing prices, was related both to increased use of computer-based data and to increased complexity. Product managers at Young's noted that Chili product managers, who faced a dynamic environment faced by Chili characterized by many trade promotions tailored to the changing demands of supermarkets in different regions, used more data than Ketchup and Tomato Paste product managers, who faced a relatively static environment characterized by few promotions or price changes. Product managers also identified frequent introductions of new varieties by either their company or its competition as affecting use of computer-based data.

Uncertainty caused by newness either of the product itself or of a competitor was identified as the third determinant of use of computer-based data. Butler's Frozen Pizza provides an example. Since this was a new product for Butler and since it differed greatly from existing products, the product managers had to analyze more data to learn how to effectively market it.

At the time these data were collected, the managers themselves were not sure whether they could solve the riddle of how to effectively market Frozen Pizza and compete with Luigi's.

When it was difficult for product managers to analyze their environment, they used less computer-based data. These relatively less analyzable environments were characterized by either a reliance on advertising as a principal marketing tool or on the identification of fads through consumer observation. Since certain products that faced a very analyzable environment, like Young's Tomato Paste, used little computer-based data, we noted that analyzability was a necessary, but not a sufficient, condition for increased use of computer-based data.

The concept of configurations, introduced by Miller (1986) in the study of strategy and structure at the organizational level, proves to be valuable in the study of use of computer-based data at the functional level. Three groupings of environment, marketing mix and use of computer-based data can explain many of the differences among products.

Of the three configurations, the responsive is the most dependent on computer-based data. Product managers in this configuration used data to understand the nuances or a complex and dynamic marketplace, by examining the impact of specific marketing actions (e.g., a competitor's recent promotion in Seattle). As the amount of computer-based data increases and the difficulty of analyzing these data decreases, we would expect to see more products move from the traditional into the responsive configuration.

Analysis of computer-based data also played a critical role for products in the new player configuration. The increased data availability made it easier for product managers to respond to new competitors or to assess the viability of their own new products. Managers with products in this configuration used data to develop an understanding of the new marketing environment. Hedberg and Jonsson (1978) hypothesized that organizations facing uncertain environments will create knowledge by making and testing hypotheses. Facing high uncertainty, product managers tried different pricing and promotion strategies and used computer-based data to determine their effectiveness. They also tried to learn from the experience of others by analyzing the strategies implemented by their competitors.

Computer-based data were less important for products in the traditional configuration. They analyzed less data, spending more time on other marketing-related tasks for their product or on another product (often a new product introduction). If managers with products in this configuration were given more data and encouraged to perform more analyses, their brand might not benefit. Their sales might even be hurt, because they were taken away from relatively more important tasks (e.g., developing new advertisements, varieties, or packaging). This observation could partly explain the lack of relationship found between use of information technology and performance (Iivari, 1987), which has been found in economic analysis conducted at the industry level. Data and analytic tools could be given to the wrong managers.

Implications for Managers

Our results indicate that organizations should try to match the amount of computer-based data and analytic tools they provide to the characteristics of the environment that managers face. Specifically, we found that the amount of computer-based data used by product managers should differ across work units based on the characteristics of their environment. Unfortunately, environment is often not considered in when determining the amount of data and analytic tools provided to managers. In our study, all the work units in each company received very similar information support. MIS and marketing managers should work together to match information processing resources, both people and technology, to the needs of specific work units.

The type of information provided to managers should also vary based on the environment faced by the work unit. Specifically, managers of products that face highly complex and dynamic environments (those products in the responsive configuration) should be able to access frequent and detailed data to track sales by region of their product and its competitors. They need this data to update and refine their knowledge of market situations. Managers of products facing uncertain environments (those in the new player configuration) need access to results of marketing experiments. It is critical for them to develop an understanding of the impact of changes in the 4Ps on sales of their product and its competitors. These needs should be more short-term. As the uncertainty is reduced through data analysis, the need for more data will also be reduced. Managers of products facing relatively simple, stable, and certain environments (those in the traditional configuration) need data to identify abnormal marketing events. Exception reports can make them aware of major changes in the marketing environment that could affect their product.

Although configurations are considered relatively stable (Miller, 1986), organizational situations evolve as time passes. Hence, changes in environment might cause a product to require more (or less) computer-based data. When this occurs, managers must take immediate action, adjusting the amount of data available to match a change environment. Further, the types and techniques of information provision should be reviewed and revised on a regular basis by both marketing and information systems managers to ensure that each work unit has the appropriate level of information support.

Several broad trends should affect the overall movement of products among configurations. The growth in the number of new products, for example, should increase the number of products in the new player configuration. Further, the trend toward more regional marketing and toward more product varieties should increase the number of products in the responsive configuration. Hence, we might expect to see a growth in the number of products in these two configurations and a reduction in the number of traditional products. These two trends along with the increase in the amount of data available to marketing managers, should lead to a

greater reliance on the analysis of computer-based data in marketing management.

Finally, marketing managers should play a more active role in defining information needs. Many researchers have advocated a top-down approach to information technology planning, where resources are allocated by senior management based on the company's overall strategy (e.g., McFarlan, 1984; Porter and Millar, 1984). We propose that middle level managers should also play a critical role in the planning process. They are better equipped to anticipate changes in the environment and business unit strategy and to identify how information technology can improve their unit's effectiveness. Our view is in agreement with recent literature emphasizing the important role of empowered middle management in organizational adaptation to a changing task environment (e.g., Nonaka, 1988).

Implications for Researchers

Based on our findings researchers should reconceptualize their views about factors that affect the use of information technologies, especially — 'end-user systems' — by knowledge workers and managers. The approach employed by both the attitude-intention-behavior researchers (e.g., Davis, Warshaw, and Bagozzi, 1989; Mathieson, 1991) and the diffusion of technology researchers (e.g., Brancheau and Wetherbe, 1990) is too narrow in focus and could lead to poor recommendations for managers.

Since the environment faced by these managers plays a key role as a determinant of system use, further studies should take place with managers and not with students as subjects. Further, the design of these studies should be 'user-focused.' Rather than starting with a specific technology (e.g., spreadsheet or word processing systems), the researcher should start with the specific job requirements and data and tools used by one type of worker (e.g., CEOs, middle managers, or financial analysts). In this analysis, the researcher can then identify the relevant factors that influence use — whether they are characteristics of the technology, environment, or culture.

Further research can build on our study of configurations of strategy, environment, and use of computer-based data. Our findings should be tested with larger samples and extended to other settings both within the marketing function and in other areas of the organization. Future studies could also incorporate other aspects of the environment, for example organization culture.

Our findings can shed some light on studies of information systems implementation and diffusion. Those studies implicitly assume that increased adoption of technology is desirable for all work units. Researchers examine factors that influence speed of adoption (e.g., Cooper and Zmud, 1990). Different levels of adoption could be a healthy phenomenon, if adoption were related both to process and to characteristics of the work unit's environment.

Products facing highly complex, dynamic, or uncertain environments should provide a rich

testing ground for organizational researchers. Drucker (1988) and others have predicted that as organizations become more 'knowledge-based' decision making should move to lower levels. Further examination of product management organizations could test this hypothesis. We might expect those product managers who face highly complex, dynamic, or uncertain environments will take more responsibility for managing the marketing mix — adjusting price and promotions or responding to new competitors and rolling out new varieties. Further, we might expect that successful organizations will give these managers more decision-making authority and the data and analytic tools they need to make these decisions.

Further insights into the relationship among managers' understanding of the environment and their use of computer-based data could be gained using research on management cognition and cognitive learning theory. Our data point out that product managers use data to learn about their environment. We might expect those managers who analyze a great deal of data to know more about their products, competitors, and customers than their counterparts. Sujan, Sujan, and Bettman (1988) and Szymanski (1990) have studied differences in cognition in marketing tasks. Their approaches could be adapted to study, for example, differences in categorization of customers or competitors between heavy and light users of computer-based data. We might expect to find that heavy users have more elaborate classification schemes than light users. Further, we could examine how this incremental knowledge affects the strategies that these managers employ.

Finally, the relationship between computer-based data and other data sources should be examined. While product managers relied heavily on computer-based data, they also used other data sources, including information provided by other managers and observations in supermarkets. Daft, Lengel and Trevino (1987) found that characteristics of the environment affect the roles of different data sources and their relative importance to managers.

The findings of this study also point out the benefits of using the marketing function in information systems research. Since marketing is at the boundary of the organization and its environment, its information needs are quite extensive. In addition, changes in information technology have led to a large increase in the amount and type of data available to marketing managers. The widespread availability of supermarket scanner data and of detailed customer data bases, for example, have the potential for causing both significant increases in the use of data by marketing managers and significant change within the marketing function. Hence research set in marketing or other boundary spanning work units (e.g., R&D or engineering) could provide valuable insights for information systems researchers.

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APPENDIX: GUIDELINES FOR PRODUCT MANAGER INTERVIEWS

I. Introduce self and project, stressing confidentiality of the study.

II. Tell me a little about your education and work background -- before arriving at _____ and since your arrival.

III. Tell me about the product you are responsible for.

- **A. Is the category/product growing or shrinking and at what rate?**
- **B. Who are the main competitors? What is their share? What are they doing?**
- **C. How is your performance measured (e.g., volume, share, profit)?**

IV. What are the important tasks that you perform? For each task:

- **A. Describe it.**
- **B. What information do you use in carrying out the task?**
- **C. Where does the information come from? Probe to find out what information is coming from people and what is coming from the computer.**
- **D. What analytic tools do you use (if any) in performing the task? What tools are used by others to provide you with the information that you see?**
- **E. What is the impact of having this information on the performance of the task? How would you do the task differently with more or less information?**
- **F. What is the most important information that you use for each task?**

V. Are there other ways that you use information or analytic tools in your work? Gather information on the use of personal computers, PC software, mainframe computers and software, electronic mail, etc..

VI. Is there other information that you receive from others that you use in your work?

VII. What factors influence your use of information technology?

- **A. What aspects of the company influence your use?**
- **B. What aspects of your division or business unit?**
- **C. What aspects of the product?**
- **D. What aspects of yourself?**

VIII. Has the availability of data and analytic tools had any measurable affect on your performance? Has it led to increased market share or sales volume, or to reduced costs?

IX. What, if any, changes do you expect to occur in the next few years?

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